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Waves in air impurities and their influence on atmospheric optical properties

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Abstract

A three years time series of data of gas concentrations and aerosol measurements have been obtained by five automatic stations separated by distances between 1 and 6 km. The data were analyzed statistically with respect to periodicity and wave structure of the pollutants/gases. The gas and aerosol concentrations as well as the meteorological parameters have the same spectra in the bottom troposphere. The periods of waves vary from 5 min up to 6 h and their spatial sizes vary from 1 up to 50 km. The influence of wave disturbances on the electromagnetic waves propagation is discussed.

Keywords: Wave processes; Atmospheric aerosol

1. Introduction

Wavelike variations of various parameters in the atmosphere create irregularities in the concentration of impurities. Detailed information on the aerosol and spatial distribution of impurities and their temporal variation has implications on climate, health and transport of chemicals. To investigate spatial parameters of aerosol variations it is necessary to measure the aerosol concentration in spatially separated points simultaneously. Wavelike variations of impurities influence propagation of electromagnetic waves in the atmosphere. In this paper, the refraction angle dispersion for electromagnetic waves due to mesoscale variations of impurities is considered.

2. Experimental measurements

In this work, we used a databank of measurements of concentration of hydrogen sulfide, monoxide of nitrogen, dioxide of nitrogen, monoxide of carbon, dioxide of sulfur and aerosol by network of five automatic stations in an urban region of Eastern Europe (Almetyevsk: 53°N, 51°E).

Measurements of the concentration of oxides of nitrogen are made by chemiluminescent gas-analyzer. The analysis for measurements of SO_2 concentration is based on ultraviolet fluorescence. The time resolution is 1 min, accuracy of measurement is 1 $\mu g/m^3$.

The concentration of the aerosol was measured, using the following principle: air, containing an aerosol is filtered. The filter containing the particles is penetrated by beta radiation. Due to the aerosol particles deposited in the filter, the beta radiation is attenuated. At intervals of 30 min the decrease of the radiation is registered. The accuracy of measurement is 1 $\mu g/m^3$ (MeduiUm-SENSOR GmbH, 1994).

For reliable and reproducible measurements, the measuring compartment was kept at a constant temperature and humidity. All devices are equipped with modern electronics and a microprocessor. The received data are written in the data bank on the hard disk of the computer.

Sampling took place at height of 2.4 m above ground, here also the meteorologic data—wind velocity and

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